Towards Zero-Energy Houses: An Integrated Approach for Reducing Cooling Energy Use

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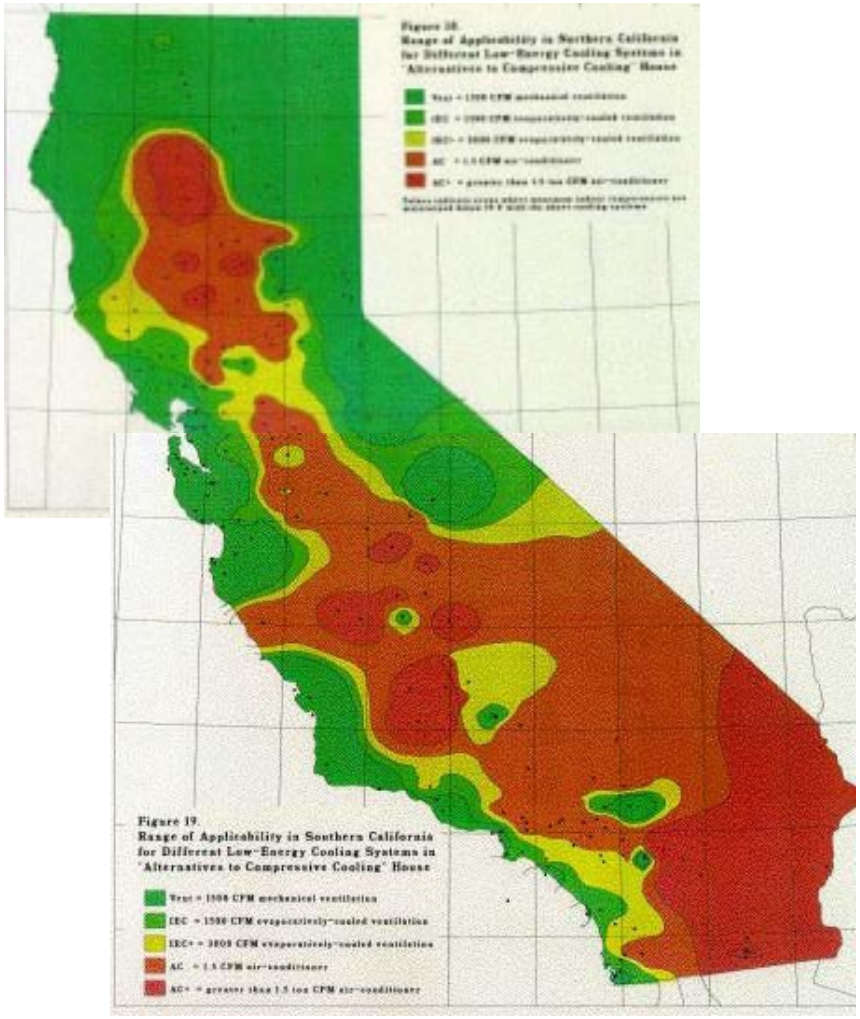
Observations from previous projects

- "Applicability of Evaporative Cooling to California Climates", California Institute for Energy Efficiency, 1992-1993
- "Alternatives to Compressive Cooling", California Institute for Energy Efficiency 1994-1999, California Energy Commission PIER 2000-2001
- "Low Energy Cooling", US representative to International Energy Agency Annex 28, 1993-1998

The Applicability of Evaporative Cooling in California Residences

(from final report of "Alternatives to Compressive Cooling" project)



Coastal locations can be comfortable at peak hours with ventilative or evaporative cooling

Inland locations have significant downsizing opportunities, but still need some A/C during peak cooling periods.

Low-Energy Cooling Case Studies
(from IEA Annex 28 Subtask 3 report)

Residence,
Portugal
Night Cooling
Natural Ventilation

Office Building,
Switzerland
Slab Cooling
(Water)

University Design
Studio, UK
Night Cooling
Natural Ventilation

Office Building,
Switzerland
Slab Cooling and
Heating (Water)

Office Building, UK
Night Cooling
Mechanical
Ventilation

Residence, USA
Slab Cooling
and Evaporative
Cooling

Representative Low Energy Cooling Techniques
(from IEA Annex 28 Subtask 2 report)

- Ventilative cooling
- Night cooling
- Slab cooling (air)
- Slab cooling (water)
- Evaporative Cooling (direct, indirect)
- Desiccant Cooling
- Chilled ceilings/beams
- Displacement ventilation
- Ground cooling (air)
- Sea/river/lake/aquiver cooling

What is Low-Energy Cooling ?

- Terminology is not precise
- Generally refers to various methods to provide cooling in an energy efficient manner that avoids or minimizes the use of refrigeration cooling
- Methods include
  - ❖ utilizing natural heat sinks in the ambient environment (air, water, wind, soil) or the building fabric to meet cooling needs.
  - ❖ energy-efficient delivery of cooling from either natural or mechanical sources.

Characteristics of Low Energy Cooling Systems

- Cooling capacity highly variable depending on climate conditions, high when conditions are mild, limited during typical summer conditions, and low or non-existent during peak cooling hours.
- Integrated with building design and operations
  - Limited cooling capacities require that envelope and internal loads be kept as low as possible
  - Optimized controls necessary to maximize cooling potentials of pre-cooling or night cooling strategies
- Integrate with conventional mechanical systems, i.e., hybrid systems to meet peak conditions or provide a safety net.
- There is no “free lunch” !

Use of Low-Energy Cooling as a strategy to achieve Zero-Energy New Housing

- California climates are favorable for the use of Low-Energy Cooling
- Low-Energy Cooling have the potential of greatly reducing space cooling energy use in California houses.
- Careful integration of building and system design is needed to prevent degradation of indoor comfort, and more research needed on improved controls or conveniently packaged hybrid systems.
- Numerous studies have identified the applicability and energy-saving potentials of Low Energy techniques and systems in California, but “business as usual” practices are still far removed adopting such techniques.

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